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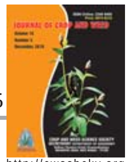

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Effect of 2, 4-D ethyl ester 80% EC on weed and yield of wheat in *Gangetic* plains of West Bengal

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ABSTRACT

A field trial was conducted during Rabi season of 2013-14 at the RRS, New Alluvial Zone, Chakdaha, BCKV, West Bengal to study the bio-efficacy and phytotoxicity of 2,4-D Ethyl Ester 80% EC in wheat. The experiment comprising of eight treatments and three replications was laid out in a Randomized Block Design. Applications of 2,4-D EE 80% EC @ 0.90 kg a.i.ha^{-1}and 0.675 kg a.i. ha^{-1} have resulted in significant effective weed control in wheat along with simultaneous enhancement of grain yield. The said treatments were statistically superior to two round of hand weeding and other market available formulation i.e. 2,4-D EE 38% EC. Even up to 0.9 kg a.i.ha^{-1} of 2,4-D EE 80% EC application, there was found no phytotoxicity in wheat. So, this treatment can be a good option for managing weed in wheat under medium land condition of sub-humid, sub-tropical condition of West Bengal.

Keywords: Bio-efficacy, 2, 4-D ethyl ester, phytotoxicity, wheat and yield

Wheat (*Triticum aestivum* L.) is one of the most significant food crops of world playing crucial role in global food security by providing adequate nutrition. Wheat crop grows in India across the exceptionally diverse range of environments. India is the second largest producer of wheat, accounting 12 per cent of the global production.Wheat production reached to 102.19 million tones with an approximate national productivity of 3,371 kg ha^{-1} during 2019 (Director's Report 2019, IIWBR, Karnal). But for West Bengal, wheat contributes only 5.15 per cent to the total food grain production and 3.1 per cent to national production (Rana *et al.,* 2017). Among the factors which adversely impact the productivity of wheat crop, weed infestation is the most harmful one but less noticeable. Weeds can incur a grain yield loss of 48 per cent in wheat (Khan and Haq, 2002). However, the magnitude of weed-related losses depends on the type and density of a particular weed species, its time of emergence, and the duration of the interference (Estorninos *et al*., 2005; Hussain *et al*., 2015; Fahad *et al*., 2015). Up to 45 weeds species have been reported in wheat field in different wheat-growing areas of the country (Qureshi and Bhatti, 2001). Weed causes severe damage to wheat crop at its different growth stages. Weeds compete with wheat for nutrients, water, moisture, light and ultimately drastically reduce crop yield. The weeds are proverbial yield reducers that are, in many situations, economically more important than insects, fungi or other pest organisms. To achieve higher wheat productivity, weeds must be removed during critical period of crop-weed competition which falls in between 0 to 30 days of sowing (Saha *et al*., 2016). In other words, if the weeds are not checked at the critical stages of crop growth, they may cause heavy reduction in crop yield upto 66 per cent (Kumar *et al*., 2011). Hence, the eradication of weeds from the crop growing areas is urgent concern for obtaining maximum returns. The various methods for eradication of weeds are hoeing, weeding, tillage, harrowing, crop rotation, biological and chemical controls. But time consuming and costly labour-intensive traditional methods have made the use of herbicides popular among Indian farmers. Keeping the magnitude of these situations in view, it is necessary to select the suitable chemicals capable of controlling effectively and economically all the type of weeds present in wheat crop. 2,4-D Ethyl Ester is such an exigent selective herbicide in wheat field which kills many terrestrial and broadleaf weeds. 2,4-D herbicide has been using in wheat fields quite for a long time and the discovery of weed killing properties of this weedicide has proved to be one of the most important developments in realm of wheat in agriculture. In this circumstances, standardization and evaluation of 2,4-D Ethyl Ester is crucial for getting higher wheat productivity and recovery over and again. Therefore, the present trial was conducted to test the bio efficacy and phytotoxicity of this herbicide molecule.

The experiment was carried out during winter season of 2013-14 at the Regional Research Station, New Alluvial Zone, Chakdaha under Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal (23°07'N latitude, 88°52' E longitude, 9.75m above

Short communication

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Table 1: Effect of treatments on total weed population (number m^{-2}) in wheat

Treatment	Dose (kg *a.i.*ha^{-1})	20 DAS	40 DAS	60 DAS
2, 4-D EE 80% EC	0.225	2.98	4.91	5.20
2, 4-D EE 80% EC	0.450	2.50	4.12	4.90
2, 4-D EE 80% EC	0.675	2.20	3.70	4.55
2, 4-D EE 80% EC	0.900	2.00	3.12	4.40
2, 4-D EE 38% EC	0.450	2.85	4.51	5.12
Metsulfuron methyl 20% WP	0.004	2.94	4.78	5.14
Hand weeding twice	-	1.21	1.51	1.97
Unweeded control	-	10.15	14.13	16.29
SEm (±)		**0.31**	**0.56**	**0.75**
LSD (0.05)		**0.87**	**1.58**	**2.15**

mean sea level) to study the bio-efficacy and phytotoxicity of 2, 4-D Ethyl Ester 80% EC in wheat in medium land under sub-humid and sub-tropical condition of West Bengal.Soil at the experimental site (0-15cm depth) was loamy in texture containing 52.65% sand, 26.2% silt and 21.15% clay with 6.54 pH and 0.57% organic carbon (OC). Available N, P_2O_5 and K_2O contents were 194.6, 47.2 and 198.2 kg ha^{-1}, respectively. Meteorological data during the cropping season revealed that maximum and minimum temperature fluctuated between 31.5 and 19.1°C in winter 2013-14. Relative humidity prevailed between 88.1 and 50.5% in winter 2013-14. The rainfall during the experimental period (December to March) was 41.4 mm. The trial was laid down in Randomized Block Design with three replications and eight treatments comprising of four different doses of 2,4-D Ethyl Ester 80% EC (Nufarm) @ 0.225, 0.450, 0.675, and 0.900 kg *a.i.*ha^{-1}, 2,4-D Ethyl Ester 38% EC (commercial) with dose 0.450kg *a.i.*ha^{-1}, metsulfuron methyl 20% WP with dose of 0.004 kg *a.i.* ha^{-1}, twice hand weeding at 20 days after sowing and 40 days after sowing were tried and check as unweeded control. The seeds of wheat variety 'PBW-343' were sown @ 100 kg ha^{-1} in 20 cm apart rows at a depth of 2-3 cm below the soil with the help of hand tynes. The plot size was 20 m^2. Herbicides were applied as solution in water @ 500 litres ha^{-1}. The herbicide solutions were sprayed uniformly in the experimental plots as per treatments with the help of knapsack sprayer fitted with flat fan nozzle type. For counting of weed population and weed biomass, quadrate area of 0.5 m × 0.5 m was specified in every plot. Total weed population was measured as the number of weeds per unit area at 20, 40 and 60 days after sowing from the quadrates according to the weed species in situ. The observation on visual crop toxicity was done on 7, 14 and 21 days after herbicide application (DAHA) by visual assessment based on Phytotoxicity Rating Scale (PRS) 0 to 10, where 0 = No crop injury while 10 = Heavy injury or complete destruction of test crop. The visual crop toxicity symptoms like leaf injury, vein clearing, epinasty, hyponasty, scorching and necrosis were observed. For taking weed dry matter, the destructed weed samples were first washed in clean tap water, then sun-dried and hot-air oven-dried for 48 hours at 70°C and weighed. Along with these, effect of different treatments on population of broad leaf weeds, on population of sedges and grasses, weed control efficiency (WCE) were measured.

Weed control efficiency (%)

$$WCE = \frac{WDM_c - WDM_t}{WDM_c} \times 100$$

where, WDM_c and WDM_t are weed dry weight in control and treated plot, respectively. Outcomes of the treatments were measured in terms of grain yield, straw yield and harvest index.

Effect on weed density

The experimental field was utterly infested with diversified weed flora consisting of both dicots and monocots. Data (Table 1) revealed significant reduction in total weed density in the herbicide treatments. Application of 2, 4-D EE 80% EC of 0.9 kg *a.i.* ha^{-1} has resulted in effective control of all type of weeds and has recorded least weed count at 20, 40 and 60 DAS and remained at par among themselves and superior to the other treatments except hand weeding twice where weed density was minimized to a great extent. It is also distinct that, 2, 4-D EE 80% EC of 0.90 kg *a.i.*ha^{-1}was at par with its lower dose of 0.675 kg *a.i.*ha^{-1}in controlling the total weed population. In the crowd of miscellaneous weed flora, the experimental field was dominated by *Cyperus rotundus, Phalaris minor, Cyperus iria and Chenopodium album* irrespective of the dates of observations, before as well as 20,40 and 60 days after herbicide application.The weedy plots were infested with the highest densities of above weed species at all dates of observations (Table 2 and 3).The densities of these major and all the weed species were significantly reduced by the applications of 2,4-D EE 80% EC of 0.90 kg *a.i.*

Table 2: Effect of treatments on population of broadleaved weeds (number m^{-2}) in wheat

Treatment	Dose (kg *a.i.* ha^{-1})	Broadleaved weeds											
		C. album			*C. arvense*			*F. parviflora*			*A. arvensis*		
		20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS
2, 4-D EE 80% EC	0.225	1.43	2.02	2.19	0.47	0.53	0.46	1.01	1.70	1.67	0.72	1.06	1.44
2, 4-D EE 80% EC	0.450	0.99	1.47	2.04	0.25	0.37	0.23	0.83	1.13	1.41	0.45	0.86	0.95
2, 4-D EE 80% EC	0.675	0.95	1.39	1.82	0.17	0.35	0.22	0.74	1.07	1.38	0.43	0.77	0.95
2, 4-D EE 80% EC	0.900	0.84	1.37	1.81	0.16	0.18	0.17	0.59	0.89	1.06	0.42	0.57	0.77
2, 4-D EE 38% EC	0.450	1.08	1.83	2.08	0.28	0.18	0.30	0.89	1.46	1.61	0.60	0.98	1.06
Metsulfuron methyl 20% WP	0.004	1.27	1.84	2.16	0.38	0.42	0.46	0.94	1.47	1.47	0.64	0.99	1.09
Hand weeding twice	-	0.43	0.69	0.83	0.07	0.09	0.08	0.32	0.53	0.57	0.20	0.41	0.42
Unweeded control	-	4.22	6.27	5.75	0.70	1.10	1.09	3.12	5.17	3.97	2.01	3.14	2.87
SEm (±)		**0.15**	**0.26**	**0.29**	**0.03**	**0.06**	**0.06**	**0.12**	**0.22**	**0.20**	**0.09**	**0.14**	**0.16**
LSD (0.05)		**0.37**	**0.68**	**0.81**	**0.08**	**0.14**	**0.14**	**0.31**	**0.58**	**0.52**	**0.18**	**0.35**	**0.41**

Table 3: Effect of treatments on population of sedges and grasses (number m^{-2}) in wheat

Treatment	Dose (kg *a.i.* ha^{-1})	Sedges						Grasses								
		C. rotundus			*C. iria*			*P. minor*			*C. dactylon*			*A. fatua*		
		20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS
2, 4-D EE 80% EC	0.225	2.12	3.50	3.64	1.28	2.54	2.53	1.64	2.43	2.91	0.72	1.04	1.26	1.02	1.51	2.15
2, 4-D EE 80% EC	0.450	1.59	2.38	2.92	1.11	1.58	1.86	1.08	1.98	2.37	0.46	0.88	0.71	0.66	1.22	1.35
2, 4-D EE 80% EC	0.675	1.50	2.09	2.67	1.03	1.56	1.84	0.73	1.91	2.06	0.23	0.87	0.64	0.48	1.19	1.19
2, 4-D EE 80% EC	0.900	1.36	2.09	2.53	0.96	1.13	1.70	0.69	1.29	1.30	0.21	0.34	0.53	0.42	0.80	0.94
2, 4-D EE 38% EC	0.450	1.63	2.47	3.44	1.14	1.65	1.94	1.28	2.00	2.61	0.46	0.93	0.76	0.78	1.29	1.67
Metsulfuron methyl 20% WP	0.004	1.85	2.89	3.46	1.14	1.95	1.95	1.31	2.23	2.89	0.58	1.01	0.93	0.94	1.47	1.80
Hand weeding twice	-	0.78	0.74	1.10	0.42	0.53	0.67	0.71	0.85	1.01	0.26	0.15	0.47	0.45	0.54	0.77
Unweeded control	-	5.76	9.77	10.75	3.68	5.49	8.80	4.93	6.07	8.60	2.63	2.18	2.66	3.40	3.21	4.38
SEm (±)		**0.21**	**0.40**	**0.49**	**0.15**	**0.26**	**0.38**	**0.16**	**0.25**	**0.39**	**0.08**	**0.11**	**0.17**	**0.13**	**0.17**	**0.22**
LSD (0.05)		**0.54**	**1.07**	**1.39**	**0.38**	**0.68**	**0.97**	**0.38**	**0.70**	**1.08**	**0.17**	**0.27**	**0.36**	**0.31**	**0.43**	**0.58**

Table 4: Effect of treatments on total weed dry matter and weed control efficiency in wheat

Treatment	Dose (kg *a.i.* ha^{-1})	Weed dry matter production (g m^{-2})			Weed control efficiency (%)			Phytotoxicity observation		
		20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS	7 DAHA	14 DAHA	21 DAHA
2, 4-D EE 80% EC	0.225	1.21	2.56	2.98	83.47	68.47	58.26	0	0	0
2, 4-D EE 80% EC	0.450	1.09	1.78	2.52	85.11	78.08	64.71	0	0	0
2, 4-D EE 80% EC	0.675	1.05	1.49	2.40	85.66	81.65	66.39	0	0	0
2, 4-D EE 80% EC	0.900	1.00	1.39	2.11	86.34	82.88	70.45	0	0	0
2, 4-D EE 38% EC	0.450	1.16	2.00	2.67	84.15	75.37	62.61	0	0	0
Metsulfuron methyl 20% WP	0.004	1.20	2.11	2.79	83.61	74.01	60.92	0	0	0
Hand weeding twice	-	0.67	0.85	1.02	90.85	89.53	85.71	0	0	0
Unweeded control	-	7.32	8.12	7.14	0.00	0.00	0.00	0	0	0
SEm (±)		**0.19**	**0.31**	**0.37**	-	-	-			
LSD (0.05)		**0.40**	**0.86**	**1.01**	-	-	-			

ha^{-1} mostly followed by 2,4-D EE 80% EC of 0.675 kg *a.i.*ha^{-1} even with greater efficacy than other popular doses of 2,4-D EE 80% EC and metsulfuron methyl 20% WP herbicides. The unweeded control treatment recorded the highest weed count (Table 1) at all the observations with the pre dominance of broad leaf weeds followed by sedges and grasses respectively. Therefore, data regarding weed population exhibited that application of 2, 4-D EE 80 % EC 0.90 kg *a.i.*$ha^{-1}$was proved most effective in controlling individual weed species *viz*., *C. album, Cirsium arvense, Fumaria parviflora, Anagallis arvensis* in broad leaved weeds, *C. rotundus, C. iria* in sedges and *P. minor, Cynodon dactylon, Avena fatua* in grasses at all the stages of observation. These consequences are in conformity with the research findings of Kundu *et al*., 2018 where it was revealed that 2, 4-D ethyl ester 80% EC 3.6 kg *a.i.*ha^{-1} has resulted in effective control of all type of weeds and has recorded least weed population at 20, 40 and 60 DAS and remained on par among themselves and superior to the other treatments except hand weeding.

Effect on weed biomass and weed control efficiency

The dry matter production of weeds was recorded at 20, 40 and 60 DAS and data from the table 4 transpired that the biomass of the weed species also differed significantly between herbicide treatment with 2,4-D EE 80% EC of 0.90 kg *a.i.*ha^{-1}, 2,4-D EE 80% EC of 0.675 kg *a.i.*ha^{-1} and other doses of same herbicidal treatments except for twice hand weeding at 20 and 40 DAS in which weed biomass production were recorded lowest among all the treatments that followed a trend like that of weed density. Application of 2, 4-D EE 80% EC 0.90 kg *a.i.*$ha^{-1}$and 0.675 kg *a.i.* ha^{-1} registered low weed dry matter productions of 1.00, 1.39, 2.11 g m^{-2} and 1.05, 1.49, and 2.40 g m^{-2} during 20, 40 and 60 days of observations, respectively. The weed dry weight in the aforesaid treatments remained on par among themselves and remain significantly superior to the other treatments at all the stages especially that of the standard treatments viz., 2,4-D EE 80% EC 0.225 kg *a.i.*ha^{-1}2,4- D EE 80% EC (Nufarm) 0.45 kg *a.i.*ha^{-1}, 2,4-D EE 38% EC (commercial) 0.45 kg *a.i.*ha^{-1} and metsulfuron methyl 20% WP 0.004 kg *a.i.*ha^{-1} .

The indices weed control efficiency derived from the weed dry weight which disclosed the result that amongst all the treatment combinations, the maximum value of weed control efficiency was achieved for hand weeding twice of 90.85, 89.53 and 85.71per cent during 20, 40 and 60 DAS, respectively. This was followed by 2, 4-D EE 80% EC 0.90 kg *a.i.*ha^{-1} and 2, 4-D EE 80% EC 0.675kg *a.i.*ha^{-1}. The weed control efficiency of the aforesaid treatments remained comparable with each other and better than other treatments. The lowest WCE

Table 5: Effect of treatments on grain and straw yield of wheat and harvest index

Treatment	Dose (kg *a.i.* ha^{-1})	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)
2, 4-D EE 80% EC	0.225	1.88	2.96	38.84
2, 4-D EE 80% EC	0.450	2.72	3.80	41.71
2, 4-D EE 80% EC	0.675	2.79	3.92	41.58
2, 4-D EE 80% EC	0.900	2.80	4.00	41.17
2, 4-D EE 38% EC	0.450	2.37	3.58	39.83
Metsulfuron methyl 20% WP	0.004	2.00	3.15	38.83
Hand weeding (Twice)	-	2.90	4.25	40.55
Unweeded control	-	1.25	2.30	35.21
SEm (±)		**0.29**	**0.32**	**-**
LSD (0.05)		**0.80**	**0.85**	**-**

was recorded in unweeded control plot. Higher the dose of 2,4-D EE 80% EC greater was the weed control efficiency (WCE). Researchers and Scientists in different years have also proven that WCE reflects the effectiveness of applied weed management treatments in securing yield against weed competition.

Phytotoxicity

The visual crop toxicity symptoms were not detected. Herbicide carryover effect was not observed in any of the herbicide treatments with different doses. It is also distinct from the table 4 that no crop phytotoxicity symptoms were traced even at the highest dose of 2,4-D EE 80% EC 0.90 kg *a.i.*ha^{-1}. The result can be confirmed by the observations of Kaur *et al*. (2017) which stated that no phytotoxicity exhibited on wheat crop treated either with sole pinoxaden or pre-mixture of pinoxaden and clodinafop and there were no crop phytotoxicity symptoms among the different treatments as well as at the highest dose of 2,4-D ethyl ester 80% EC 3.6 kg *a.i.* ha^{-1}and these results are in conformity with the findings of Kundu *et al*., 2018 where it was found safe for wheat crop.

Effect on yield and harvest index of wheat

The data presented in the table 5 revealed that among herbicides, application of 2, 4-D EE 80% EC 0.900 kg, 0.675 kg and 0.450 kg *a.i.*ha^{-1}being at par among themselves recorded significantly higher grain and straw yield which was statistically similar to the yields obtained with hand weeding twice and 2,4-D EE 38% EC. Low infestation of weeds as evident from lower weed count and dry weight by these said herbicide treatments resulted in higher grain yield. The results are in conformity with the findings of Walia *et al*., 2010, Chaudhari *et al*., 2017 and Punia *et al.* 2017. The increase in the grain yield by 2, 4-D EE 80% EC 0.900 kg, 0.675 kg and 0.450 kg *a.i.* ha^{-1} was 18.14%, 17.72% and 14.76% respectively over 2,4-D EE 38% EC and 124%, 123.2% and 117.6% over check.

The study revealed 2, 4-D EE 80% EC @ 0.90 kg *a.i.*ha^{-1} and 2, 4-D EE 80% EC 0.675 kg *a.i.*ha^{-1} have resulted in significantly effective weed control followed by 2, 4-D EE 80% EC 0.425 kg a.i.ha^{-1} and contributed in significantly high grain yield through these said treatments which were statistically comparable to two rounds of hand weeding and other market available formulation of 2,4-D EE 38% EC. Even up to 0.9 kg *a.i.* ha^{-1} of 2,4-D EE 80% EC application, there was no phytotoxicity in wheat.

REFERENCES

Chaudhari, D. D., Patel, V. J., Patel, H. K., Mishra, A., Patel, B.D. and Patel, R.B. 2017. Assessment of pre-mix broad spectrum herbicides for weed management in wheat. *Indian J. Weed Sci.*, **49**: 33-35.

Director's Report (ICAR) 2019. Progress Report (All India Coordinated Research Project) (AICRP) on Wheat and Barley 2019.

Estorninos, J.E.L. 2005. Rice and red rice interference. *Weed Sci*., **5**3: 683-692.

Fahad, S., Hussain, S., Chauhan, B. S., Saud, S., Wu, C., Hassan, S., and Huang, J. 2015. Weed growth and crop yield loss in wheat as influenced by row spacing and weed emergence times. *Crop Pro.*, **71**: 101-108.

Kaur, T., Kaur, S. and Bhullar, M.S. 2017. Control of canarygrass in wheat with pre-mixture of pinoxaden plus clodinafoppropargyl. *Indian J. Weed Sci.*,**49**(3): 223-225.

Khan, M. and Haq, N. 2002. Wheat crop yield loss assessment due to weeds. *Sarhad J. Agric*., **18** : 443-457.

Kumar, S., Angiras, N. N. and Rana, S.S. 2011. Bio-efficacy of clodinafop-propargyl + metsulfuron-methyl against complex weed flora in wheat. *Indian J. Weed Sci.*, **43**: 195-198.

Kundu, C. K., Biswas, U., Kundu, A., Khan, R. and Lamana, M. C. L. 2018. Studies on bio-efficacy of 2, 4-D Ethyl Ester 80% EC in maize and its effect on succeeding crop lentil. *J. Pharmacogn. Phytochem*., **Spl**: 1514-1517.

Punia, S.S., Yadav D.B., Kaur, M. and Sindhu, V. K. 2017. Post-emergence herbicides for the control of resistant littleseed canarygrass in wheat. *Indian J. Weed Sci.*, **49:** 15-19.

Qureshi, R. and Bhatti, G.R. 2001. Determination of weed communities in wheat field of district Sukhur. *Pakistan J. Bot.*, **33**: 109-115.

Rana, L., Banerjee, H., Ray, K. and Sarkar, S. 2017. System of wheat intensification (SWI) - A new approach for increasing wheat yield in small holder farming system. *J. Appl. Nat. Sci*.,**9**(3): 1453-1464.

Saha, M., Banerjee, H. and Pal, S. 2016. Relative efficacy of herbicides in wheat. *Indian J. Weed Sci*.,**38** (2): 127-128.

Walia, U.S., Kaur, T., Nayyar, S. and Singh, K. 2010. Performance of carfentrazone-ethyl 20% + sulfosulfuron 25% WDG- A formulated herbicide for total weed control in wheat. *Indian J. Weed Sci.*, **42**: 155-158.